

## Wireless Spectrum Research and Development (WSRD) Workshop IV

### Promoting Economic Efficiency in Spectrum Use: the economic and policy R&D Agenda

# FCC delays and impact on investment & innovation

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# Background



⊕ Where does wireless innovation come from?

⊕ A combination of:

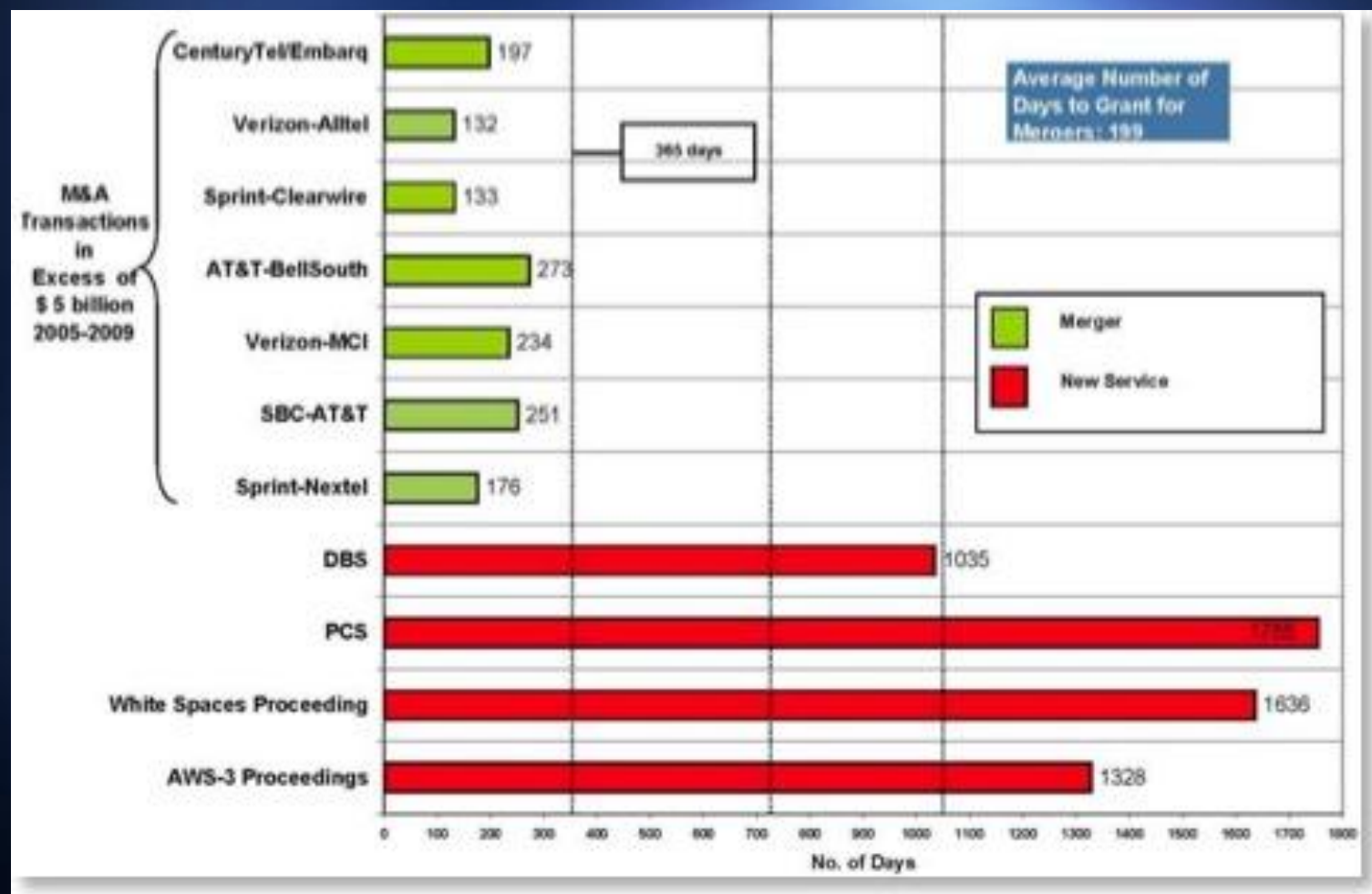
- ⊕ An technical idea
- ⊕ A perceived market
- ⊕ Capital formation
- ⊕ Market access



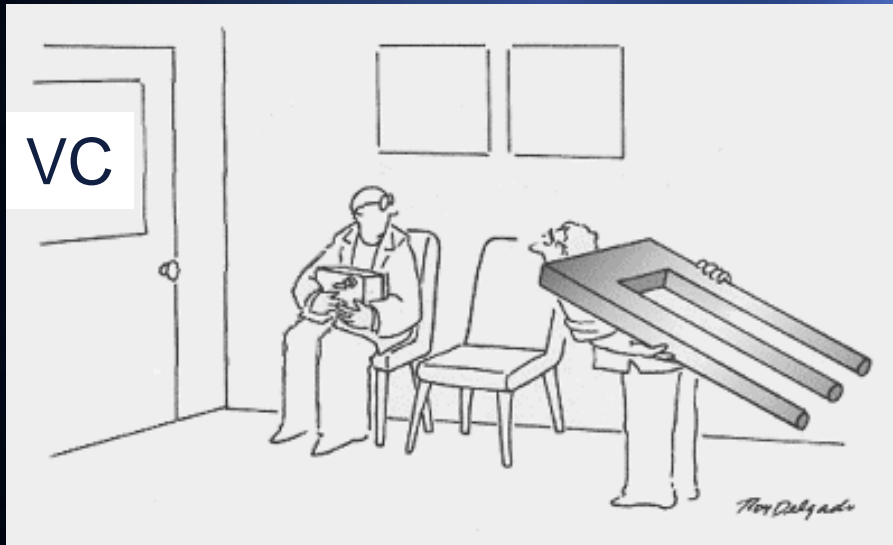
# *Risks & Investments in Technology*

- ⊕ All innovative technology business plans have risks:
  - ⊕ Can you develop the intended product on budget & on time
  - ⊕ Will customers really buy it
  - ⊕ Will a competitor arrive by surprise
- ⊕ But highly regulated technologies have an additional factor: Can I get **timely** regulatory approval?

# Some FCC Speed of Service Data



# VCs (and Angels) Have Many Applicants Seeking \$\$



- ⊕ In the waiting rooms of VCs there are wireless innovators as well as those in less regulated fields
- ⊕ Does wireless regulation & its transparency disadvantage wireless innovators?



# *Regulatory Risk*



- ⊕ Both FDA and FCC impose regulatory burdens on new technology
- ⊕ What is the relative uncertainty – as perceived by VCs and in actuality – of each agency?
- ⊕ How do VCs view business plans subject to such regulation compared to other high tech industry business plans



# *Regulatory Risk*



- ⊕ Is there is a way to make a fair comparison between FDA approval times and FCC approval times for innovative products?
  - ⊕ FDA process is not adversarial like FCC in many cases
- ⊕ What does the financial community think about the decision time at FCC on new technology issues

# Possible Wireless Innovation FCC Problem Classification

Class	Interference	Competitive Threat	Likely Regulatory Controversy	Examples
I	None	None	Small (But >2 yr delay likely)	<ul style="list-style-type: none"> <li>• Unlicensed ISM/Wi-Fi</li> <li>• &gt;95 GHz</li> </ul>
II	To Party A	None	Large	<ul style="list-style-type: none"> <li>• UWB</li> <li>• TV whitespace</li> </ul>
III	To Part A	To Party B	Large	• LightSquared/GPS
IV	To Part A	Also to Part A	<b>Huge</b>	• M2Z/AWS-3

# *Benefits*

- ⊕ Quantify the cost of delay with respect to capital availability and cost of capital that result from regulatory delay
- ⊕ Show impact compared to countries where spectrum policy is based on a state capitalism model and how this impacts US competitiveness
- ⊕ Help FCC and NTIA prioritize reforms



# US Spectrum Policy

Private sector &  
local gov't



Regulates  
nonfederal  
spectrum use

Federal gov't use



Delegated  
from  
POTUS  
47 USC 305  
authority

5 presidential  
appointees

*But NTIA really  
defers to IRAC  
for most decisions*



# *FCC & NTIA*

- ⊕ FCC – very transparent
- ⊕ NTIA – rather opaque
- ⊕ FCC/NTIA coordination needed (in practice, but not by law) for bands used by users of both agencies (very opaque)



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**Efficient Co-design of  
Radar and Civil Comm Systems**

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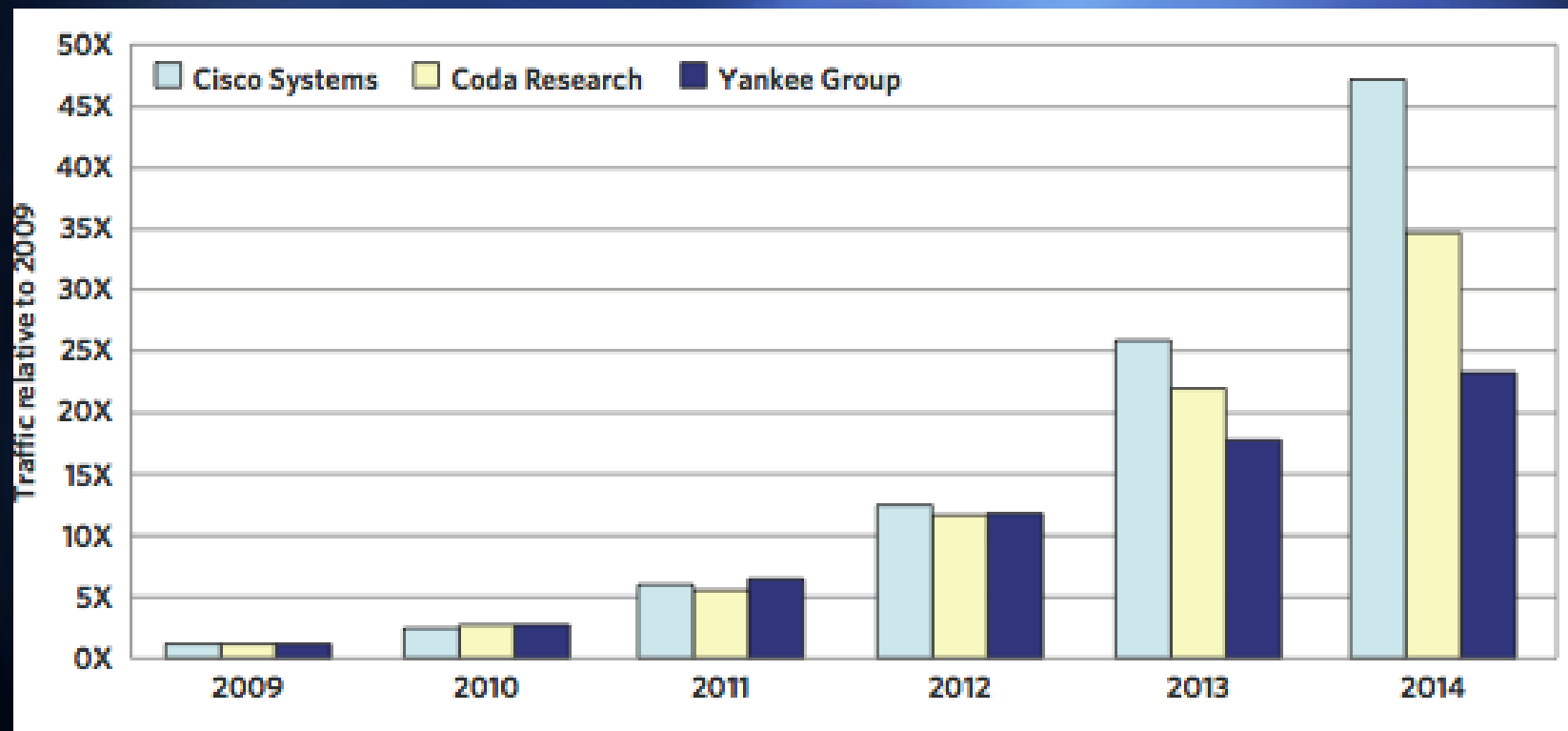
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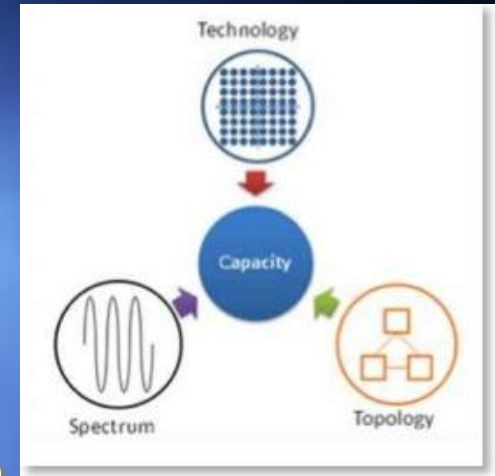
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# *Civil Mobile Traffic is Growing Rapidly*



# Meeting Demand

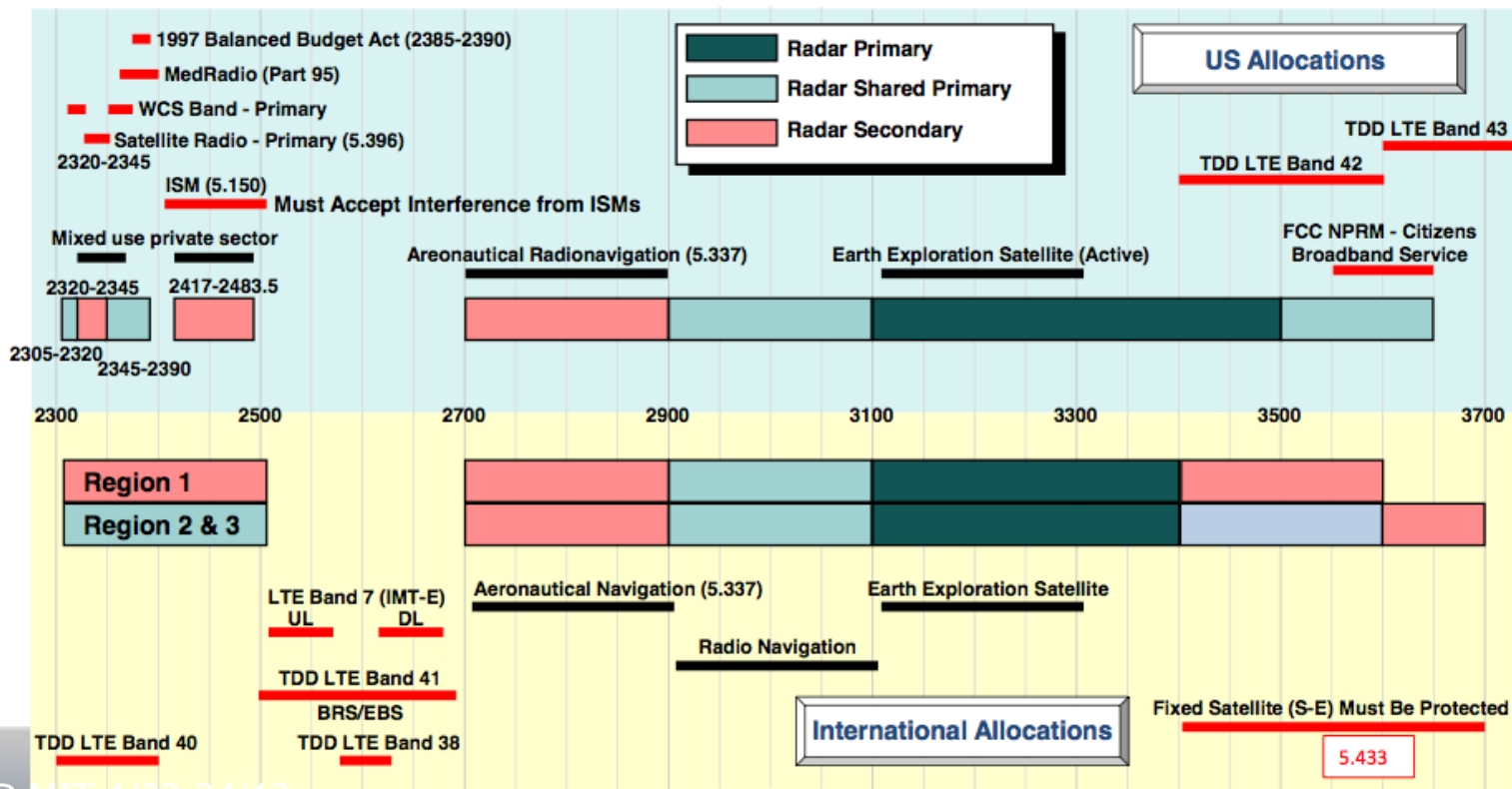
- ⊕ While industry may be focusing too much on new spectrum as a way to meet demand, new spectrum access is a key factor
- ⊕ As PCAST report shows simple reallocation is unrealistic
  - ⊕ Federal radar users have legitimate needs for functionality in certain bands



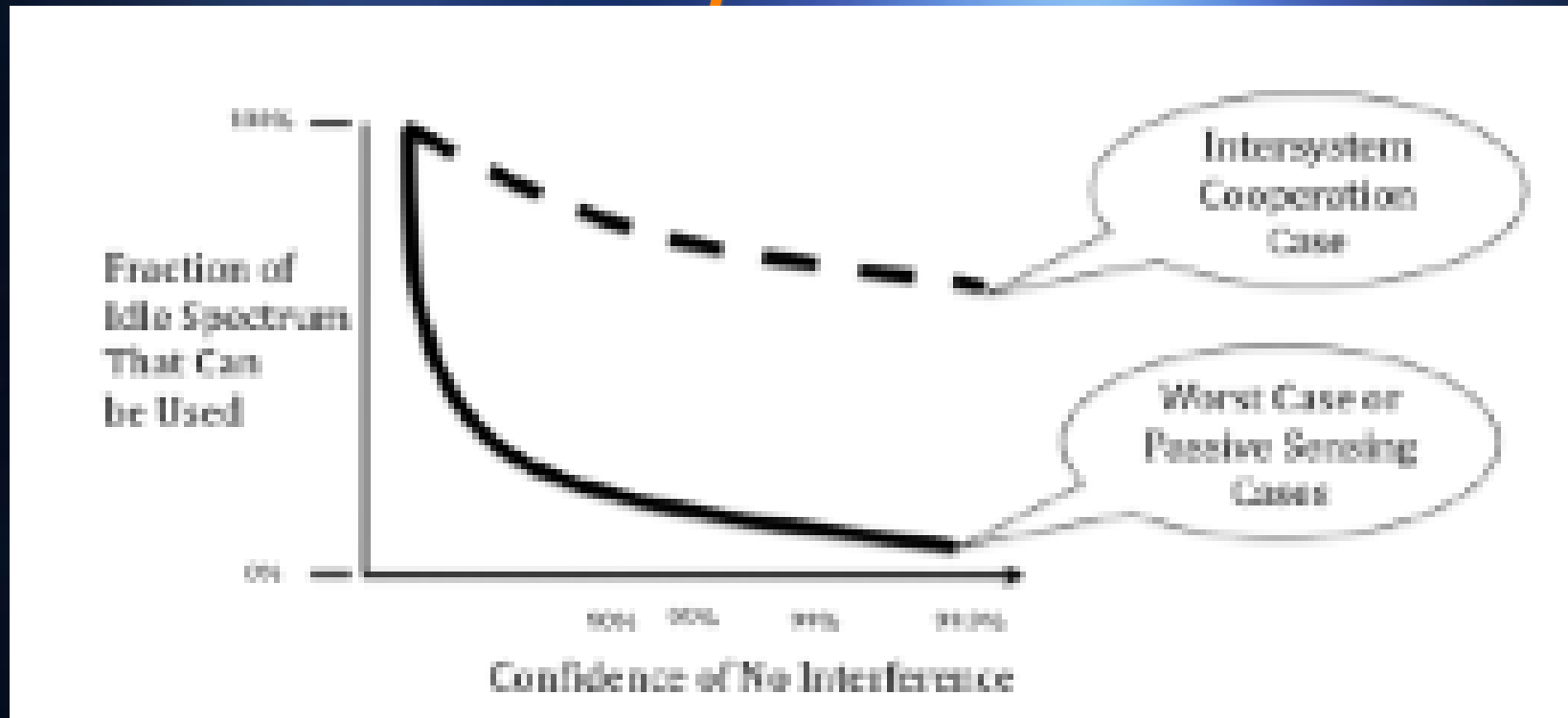
# Radar is a Big User of “Beach Front Spectrum”



## S-Band Frequency Allocations



# Passive Sensing vs. Cooperation



Goals in sharing include BOTH effective sharing AND high confidence of no interference

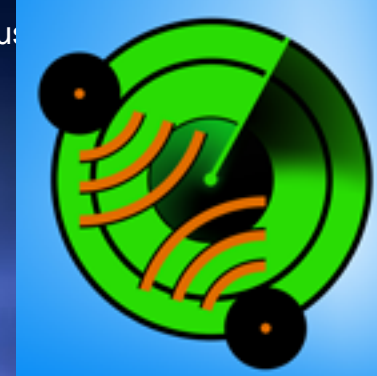
# *Reality*

- ⊕ Legacy radar systems designed when federal spectrum was a “free good” so little concern about sharing
- ⊕ Do radars have a legitimate need for 24/7 1000 ms/s exclusive use of such spectrum?
- ⊕ Sharing with legacy radars under terms dictated by NTIA/IRAC is a marginal proposition – 5 GHz lesson

# *Past Radar/Comm Sharing*

- ⊕ Past sharing attempts with incumbent radars have been problematic:
  - ⊕ Must accept radar design from an different era
  - ⊕ At best, performance of detectors bounded by “realizable” system constraints
  - ⊕ Classified waveforms prevent optimal signal detection
  - ⊕ Passive detection leads to  $P(D)/P(FA)$  tradeoff

# Relation with DARPA SSPARC



- ⊕ SSPARC focus is on military physical layer standards
  - ⊕ Not LTE
- ⊕ Mil/civil codesign excluded



## Relationship between thrusts and sharing types

Thrust	Time frame	Military / Military sharing	Military / Commercial sharing
Coexist-ence	Rapid transition	✓	✓
Codesign	Slower transition	✓	

# Design Negotiation Framework

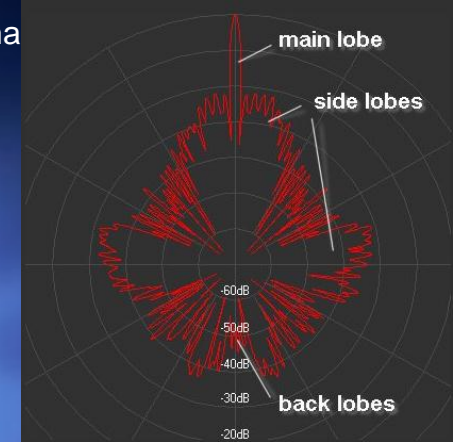


- ⊕ Radar and comm designers work as coequals to minimize total system lifetime cost
- ⊕ Are allowed to exchange money to improve performance of one design to facilitate other design's sharing

# *Radar/Comm Design Tradeoffs*

- ⊕ Radar parameters are a function of real time situation of both users
  - ⊕ power
  - ⊕ prf
  - ⊕ waveform
  - ⊕ antenna pattern (phased array assumed)
- ⊕ Order wire to share anticipated spectrum changes

# Radar Antenna Issues (For Comm People)



- ⊕ All finite size antennas must have sidelobes
- ⊕ Sidelobes impact comm ↔ radar interference
- ⊕ In many cases sidelobes exceed theoretical minimum due to design problems that can be solved with \$\$
- ⊕ But even if you are close to minimum, a phased array radar can move sidelobes in real time to control interference by changing **weights** (this impacts mainlobe)

# Security

- ⊕ Federal radar users often have real security concerns about spectrum use
- ⊕ Sharing comm users needn't have total information about spectrum use, only what is available for them at a given time
  - ⊕ Cell phones follow orders from base stations and need less info than base station
  - ⊕ Nonharmful extra information can help protect key data with a “bodyguard of lies”

# Summary

- ⊕ Civil SSPARC-like radar/comm sharing codesign can add new spectrum availability to civil broadband systems
  - ⊕ While reallocation is attractive to industry, probably isn't practical in the country with the world's largest military
  - ⊕ Vacant nationwide 24/7 military spectrum may be an ephemeral vision